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(54) Method and apparatus for transferring a pre-moulded film into a mould

(57) A method and apparatus for transferring a pre-moulded film into a cavity comprising the following steps. A robotically controlled arm (10) having a loader (14) receives flexible film (30). The loader (14) comprises two moveable end portions (18,20) and a main portion (16) there between. The pre-moulded film (30) is transferred onto the loader (14). The end portions (18,20) are retracted so that the loader (14) is in a retracted position. The loader (14) is moved to a position within a cavity (40). The cavity (40) has an opening (46) that is larger then the loader (14) when the loader (14) is in the retracted position. The film (30) is transferred to the cavity (40) by aligning the film with corresponding three-dimensional contours on the cavity (40). The end portions (18,20) are extended so that essentially the entire surface of the film contacts the cavity. The loader (14) is withdrawn from the cavity by first retracting the end portions (18,20) and removing the loader (14).

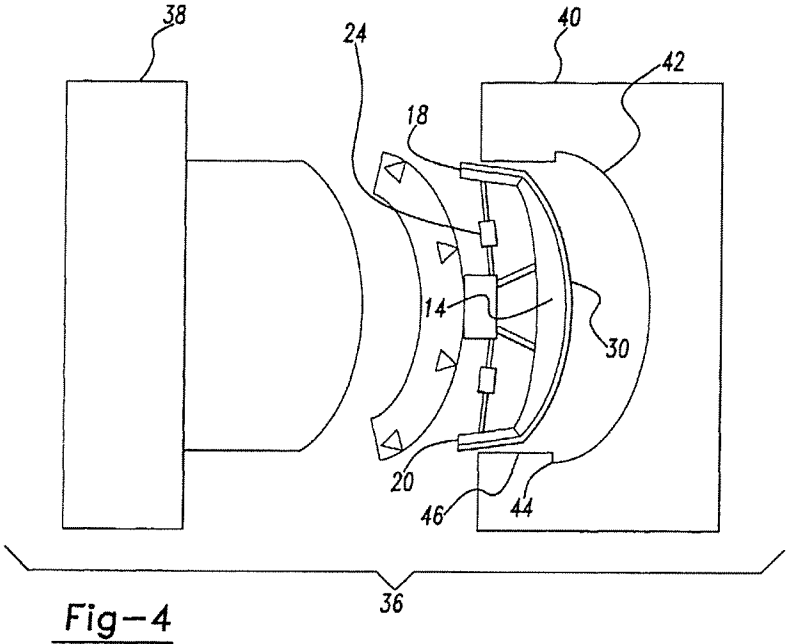

Fig-4

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Description

[0001] The present invention is directed to a method and apparatus for transferring a pre-moulded film into a mould . More specifically, the present invention is directed to providing a robotically controlled moveable arm to transfer a flexible, pre-moulded film into an injection-moulding tool.

[0002] It is known to manufacture injection moulded articles in an injection moulding press. Generally, the robotically controlled arm manipulates a device called an unloader to remove articles manufactured in the press. The unloader secures the moulded article by vacuum and lifts the moulded article from the core portion of the mould .

[0003] It is also known to manufacture moulded articles using flexible films wherein the film is placed within a mould cavity and a polymer is injected behind the film to heat and soften the film backing. The film backing fuses to the polymer to form a moulded article. An example of this type of method is taught in US patent No. 3,668,034. One difficulty in manufacturing moulded articles using pre-moulded flexible films, is properly positioning the flexible film within the mould s so that it is free of wrinkles or creases and is precisely positioned in the cavity to register with the cavity contours to form the desired article. Heretofore, proper placement of the pre-moulded film within the cavity has been a major stumbling block to widespread application of pre-moulded films. The problem is especially acute when handling thin pre-moulded films for large automotive applications such as bumper facias, instrument panels and door panels. The entire surface area of the film must be properly positioned within the cavity to produce a defect-free article. Slight misalignments will cause wrinkles or defects and make the article unusable.

[0004] It is necessary to precisely place the film between the operable core and cavity pieces of a moulding press. Because these operable pieces open and close, it is advantageous to provide a mechanism which allows the pre-moulded film to be robotically placed within the mould rather then manual placement by an operator. It is a further desired result of the present invention to utilize the existing equipment for removing the moulded article from the core, in the method for placing the pre-moulded film within the mould . It is also desired that the method and apparatus utilize existing moulding equipment to the maximum extent possible. This includes utilizing a mould press and core with a limited opening there between. It is further desirable to manufacture an article in a tool that is subject to "die-lock" conditions. Die-lock conditions occur when the moulded article has a dimension greater than the opening of the mould . Die-lock prevents the article from being removed from the cavity after the moulding operation. Utilizing die-lock conditions enables the manufacture of parts with covered edge portions or flanges.

[0005] A variety of methods are known for removing articles from mould s that are subject to die-lock, however, a method of placing flexible films within a cavity that is subject to die-lock has not been shown. It is yet another desired object of the present invention to provide a method and apparatus for placing a pre-moulded film into a cavity that is subject to die-lock conditions. It is further desirable to precisely position a pre-moulded film within a cavity so that edge portions are placed within the cavity and a flange portion is formed behind the edge portion.

[0006] It is known to form a covered edge using in-mould films. An example of this construction is illustrated in US patent No. 5,599,608. A film having a re-entrant edge portion is placed within a mould . A cavity is moved to contact the core. The core engages the re-entrant portions and folds them within the cavity. Molten plastic is injected into the cavity and the combination of closing the mould combined with the pressure the molten plastic material forces the re-entrant edge portions against the cavity wall to form the covered edge of the moulded article. The method described in US patent No. 5,599,608 is limited to forming an edge portion having a width equal to the thickness of the substrate. This is useful when forming a part having a covered edge, but not useful when forming a part having a covered flange portion. A flange creates a space behind the flange known as an undercut. The 5,599,609 patent does not teach forming parts having an undercut.

[0007] The present invention is directed to a method an apparatus for transferring a pre-moulded film into a mould comprising the following steps. A robotically controlled arm having a loader receives flexible film. The loader comprises two moveable end portions and a main portion there between. The pre-moulded film is transferred onto the loader. The end portions are retracted so that the loader is in a retracted position. The loader is moved to a position within a mould . The mould has an opening that is larger then the loader when the loader is in the retracted position. The film is transferred to the cavity by aligning the film with corresponding three-dimensional contours on the mould . The edge portions are extended so that essentially the entire surface of the film contacts the mould . The loader is withdrawn from the cavity by first retracting the end portions and removing the loader.

[0008] The invention also provides an apparatus for practicing the foregoing method. The apparatus for transferring a pre-moulded film into a mould comprises a robotically controlled arm having a moveable end. A loader is attached to the end. The loader has two moveable end portions and a main portion there between. Vacuum ports located on the end portions and on the main portion act to retain the film on the loader while the film is transferred to the mould . Extenders positioned between the end portions and the robot arm end act to extend and retract the end portions. The apparatus enables a loader having a width greater then the opening of the cavity to be inserted within the cavity . The die-

lock condition is overcome by retracting the end portions prior to inserting the film. The film is transferred to the cavity by moving the extenders to the extended position and contacting the film with the interior surface of the cavity. The loader is removed from cavity by retracting the extenders to reduce the width of the loader.

[0009] The invention enables the manufacture of film covered moulded articles having a covered flange portion. The invention further enables the handling of flexible films and easily inserting the films within a cavity without scuffing or scratching the films. It is another advantage of the present invention to provide a robotically controlled arm and loader that positions the film within a cavity that is not normally accessible by an operator. It is another advantage of the present invention to repeatedly locate a flexible film within a cavity by aligning three-dimensional contours of the film onto a cavity surface.

[0010] The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a robotically controlled loader;
Figure 2 is a detailed perspective view of the loader.
Figure 3 is a perspective view of the loader attached to a robot arm;
Figure 4 is a cross-sectional view of the loader in the retracted position;
Figure 5 is a cross-sectional view of the loader in an extended position; and
Figure 6 is an alternative embodiment of the loader illustrated in Figure 3.

[0011] Illustrated in Figure 1 is a robotically controlled arm 10. The arm 10 is moveable in both vertical and horizontal axis. The robot arm 10 includes a moveable end 12. Attached to the moveable end 12 is a loader 14. The loader 14 is rigidly fastened to the end 12. The loader 14 moves in conjunction with the end 12. The loader 14 receives a pre-moulded flexible film useful in manufacturing film-coated articles. The loader 14 receives the film from a film loading station (not shown) and transfers it into a mould . The film has a thickness of 0.19-35 mils and is not self-supporting.

[0012] Illustrated in Figure 2 is a detailed view of the loader 14. The loader 14 comprises a main portion 16 that is attached in a fixed position to the end 12. Attached to either end of main portion 16 are end portion 18, 20. The end portions 18, 20 are attached to main portions 16 by hinges 22. The end portions 18, 20 pivot or swing along hinges 22. The end portions 18, 20 are attached to the end 12 by extenders 24. The extenders 24 are pneumatically or hydraulically operated pistons that elongate or contract and act to pivot end portions 18, 20. Other suitable mechanisms to control the movement of the end portions 18, 20 include pneumatically operated cylinders, linear motors, solenoids, rack & pinion gearing or worm gearing. Located along the surface of the main portion 16 and the end portions 18,20 are a plurality of vacuum ports 26. The vacuum ports 26 are connected to vacuum lines 28 and to a pump (not shown) that draws a vacuum. The vacuum serves to retain the flexible film on the loader 14.

[0013] The loader 14 receives a thin flexible film 30 from an unloading station 32 as illustrated in Figure 3. The end portions 20 are in a retracted position and the loader 14 is moved within the loading station 32. The extenders 24 are extended and the end portions 18, 20 are moved to the extended position. The loader 14 has a surface that mates with the film 30. Vacuum is applied to vacuum ports 26 and the loader 14 receives the film 30 from the loading station 32. The construction and operation of the loading station 32 is described in co-pending US patent application 08/903523. The loading station 32 transfers the film 30 on the loader 14. The vacuum ports 26 retain the film 30 onto the loader 14. Positioned opposite the loader 14 is a pivoting unloader 34. The pivoting unloader 34 operates to remove the moulded article from a mould press 36 as will be described in more detail as shown in Figure 4.

[0014] The loader 14 is moved between an open mould press 36. The mould press 36 has a moveable core 38 and a stationary cavity 40. The cavity 40 has an interior surface 42 that mates with the film 30. The method and apparatus of the mould press is described in co-pending US patent application 08/903364, which is incorporated herein by reference.

[0015] The cavity surface 42 has an undercut portion 44 that forms a flange on a moulded article. The undercut portion 44 creates an opening 46 that is narrower than the width of the loader 14 when the end portions 18, 20 are in an extended position. To insert the loader 14 into the cavity 40, the end portions 18, 20 must be removed to a retracted position. The extenders 24 are retracted therefore moving the end portions 18, 20 to the retracted position. This reduces the width of the loader 14 less than the opening 46. The loader 14 is moved within the cavity 40 without touching or damaging the film 30. Once the loader 14 is completely inserted within the cavity 40, the end portions 18, 20 are moved to an extended position by extenders 24. The film 30 is brought into uniform contact with the cavity surface 42. Vacuum is withdrawn from vacuum ports 26 and a short positive air pressure is applied to cause the film 30 to transfer onto the cavity surface 42. The end portions 18, 20 are again moved to a retracted position by the extenders 24. The loader 14 is removed from within the cavity 40. The mould press 36 is closed and a moulded article is formed between the core 38 and cavity 40.

[0016] The invention as illustrated in Figures 1-5 generally positions the unloader 34 opposite and parallel with the loader 14. This orientation is useful when the space between the core 38 and the cavity 40 is sufficiently large to enable a parallel placement of the loader and unloader. When the opening between the core 38

and the cavity 40 is narrow, the over all width of the loader and unloader may be reduced by positioning the loader above the unloader in a stacked arrangement. This space saving alternative embodiment is illustrated in Figure 6. The loader 14' is positioned above the unloader 34. The total width of the loader 14' and unloader 34 is greatly reduced over the embodiment illustrated in Figure 5.

Claims

1. A method of transferring a pre-moulded film into a mould comprising the steps of:

   providing a robotically controlled movable arm (10), said arm (10) having a loader (14) attached to an end; said loader having two movable end portions (18,20) and a main portion (16) there between;
   transferring said pre-moulded film (30) to said loader (14);
   retracting said end portions (18,20) and placing said loader (14) in a retracted position;
   moving said arm (10) to position said loader (14) within a cavity (40), said cavity (40) having an opening (46) larger than said loader (14) while in said retracted position;
   extending said end portions (18,20) and placing said loader (14) in an extended position, said cavity opening (46) being smaller than said loader (14) in said extended position;
   transferring said pre-moulded film (30) to said cavity (40);
   retracting said end portions (18,20); and
   moving said arm (10) away from said cavity (40).

2. A method as claimed in claim 1, further comprising applying a vacuum to retain said film on said end portions and main portion.

3. A method as claimed in claim 2, after said transferring step, further comprising removing said vacuum.

4. A method as claimed in claim 3, after said vacuum removing step, further comprising applying a positive air pressure to release said film from said end portions and main portion.

5. An apparatus for transferring a pre-moulded film into a cavity comprising:

   a robotically controlled arm (10) having an end;
   a loader (14) attached to said end, said loader (14) having two movable end portions (18,20) and a main portion (16) there between;
   retainers (26) located on said end portions (18,20) and main portion retaining a pre-moulded film (30) on said loader (14); and
   extenders (24) attached between said end portions (18,20) and operable to extend and retract said end portions (18,20).

6. An apparatus as claimed in claim 5, wherein said retainers include an air tube drawing a vacuum between said film and said loader.

7. An apparatus as claimed in claim 5, wherein said end portions are pivotally attached to said main portion.

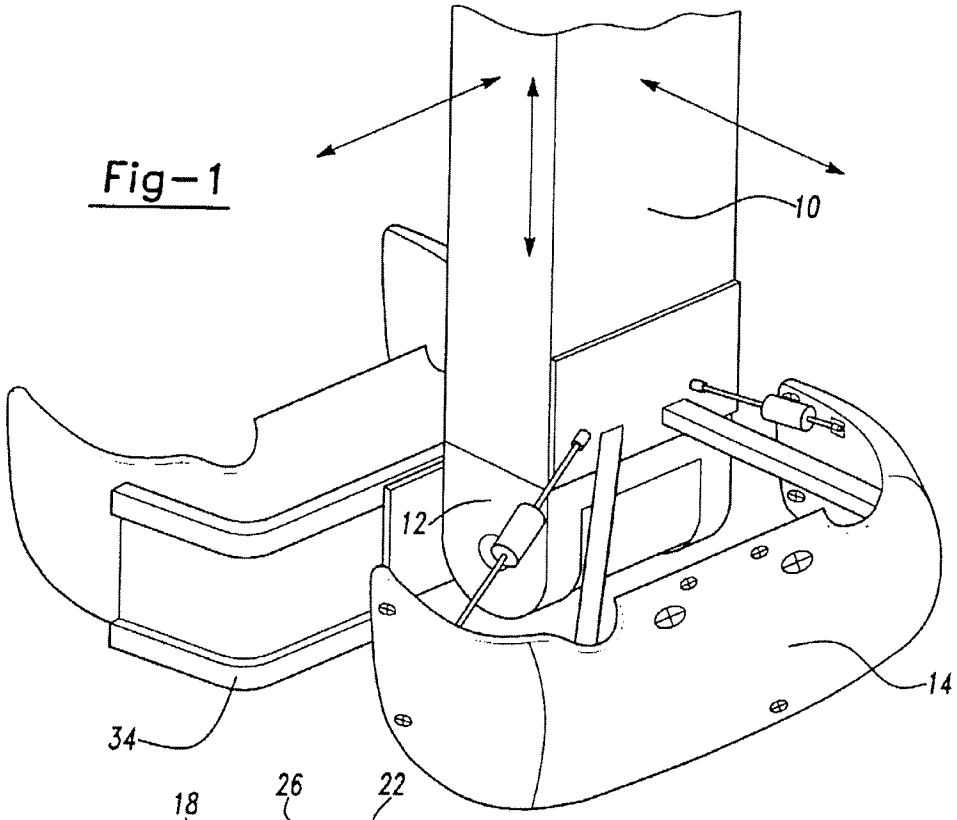
8. An apparatus as claimed in claim 5, wherein said extenders are fluid driven pistons extending and retracting within cylinders.

9. An apparatus as claimed in claim 5, further comprising an unloader pivotally attached to said end and opposite to said loader.

10. An apparatus as claimed in claim 9, wherein said arm has a longitudinal axis and said unloader pivotal attachment is aligned along said axis.

11. An apparatus as claimed in claim 5, wherein said unloader pivotal attachment is spaced a distance below said loader.

Fig-1



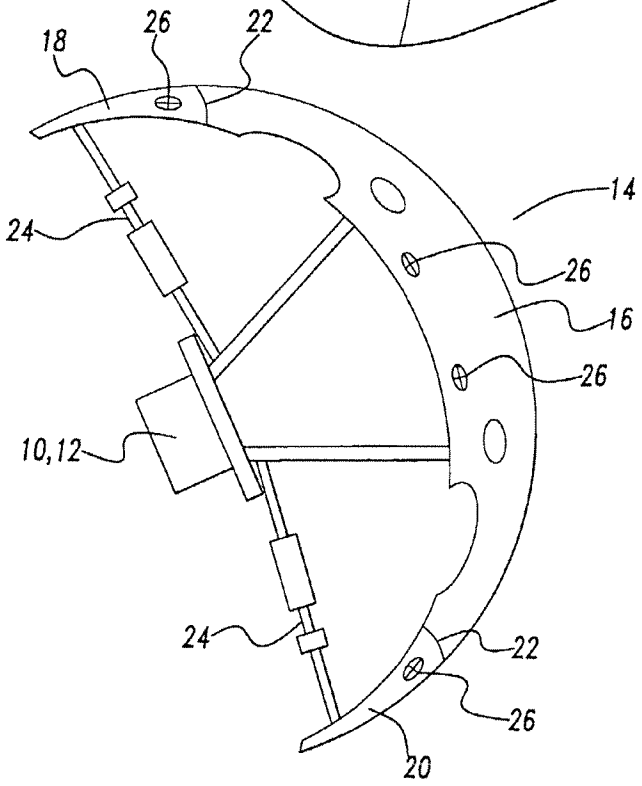


Fig-2

Fig-3

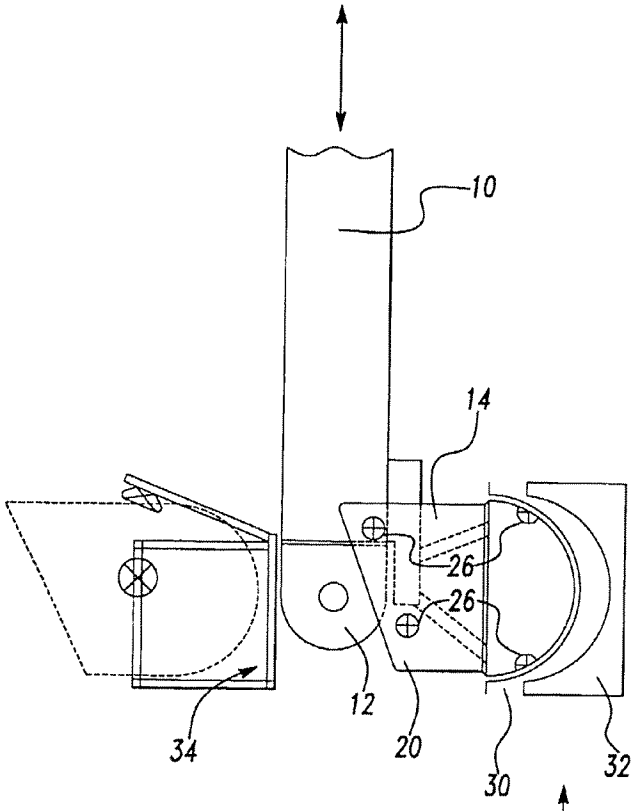
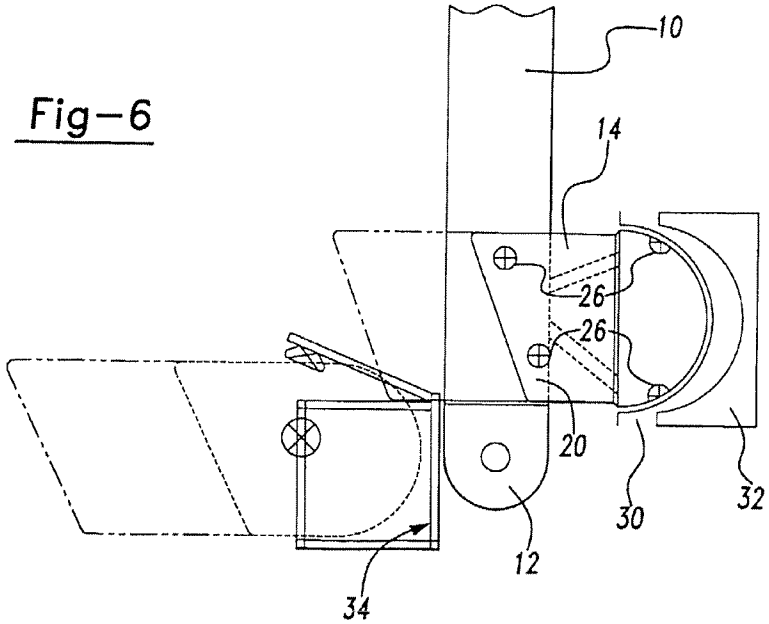


Fig-6



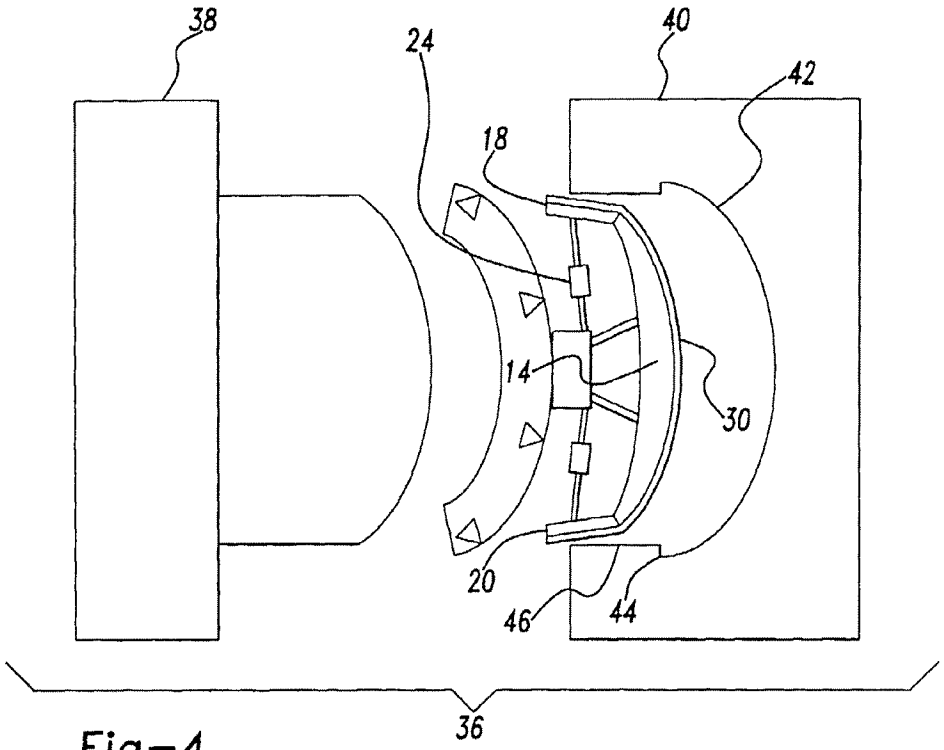


Fig-4

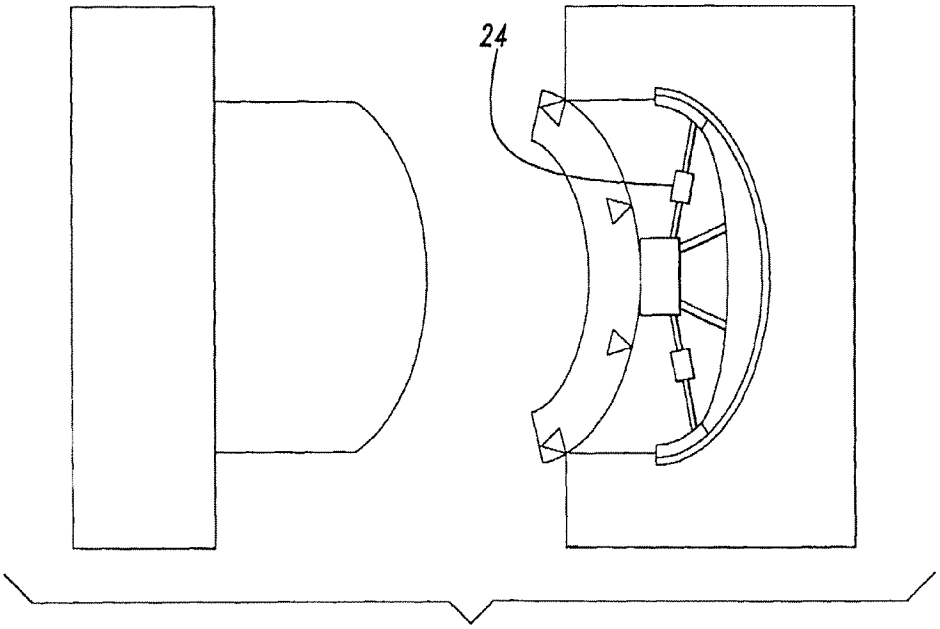


Fig-5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 5675

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	FR 2 699 888 A (RG PLASTIQUES ;GOUJON DANIEL) 1 July 1994	1-3	B29C45/14 B29C45/42
X Y	* the whole document *	5-8 9	
Y	FR 2 606 702 A (DROMIGNY PIERRE) 20 May 1988 * the whole document *	9	
A	DE 19 15 388 A (KINGSTON PLASTICS LTD) 9 October 1969 * page 7, paragraph 2 - page 9, paragraph 2; figure 4 *	1,5,6	
A	EP 0 764 513 A (INTER TOOLING SERVICES BV) 26 March 1997 * column 4, line 12 - line 26; figure 4 *	1,5,7	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 October 1998	Bollen, J

CATEGORY OF CITED DOCUMENTS

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